University-industry collaboration

Gertner, Drew

DOI:
10.1108/13673271111151992

Document Version
Peer reviewed version

Citation for published version (Harvard):
Gertner, D 2011, 'University-industry collaboration: a CoPs approach to KTPs', *Journal of Knowledge Management*, vol. 15, no. 4, pp. 625 - 647. https://doi.org/10.1108/13673271111151992

University-Industry Collaboration: A CoPs Approach to KTPs

Abstract

This article explores the micro-dimensions of Knowledge Transfer Partnerships (KTPs) with the aim of developing an appreciation of the personal interactions that facilitate the success of these university-industry collaborations. Empirical evidence concerning the operation of three KTPs, collected through interviews with the key KTP partners and the review of relevant documentary material, is analysed through the lens of the Communities of Practice approach to situated learning. The analysis of three case studies provides evidence to support the value of conceptualising the process of knowledge transfer between universities and industry as one of learning taking place within communities in which the development of mutual engagement, joint enterprise and shared repertoires play important roles facilitating successful collaborations. Moreover, the analysis highlights the significance of the boundary spanning roles of the KTP partners in facilitating the knowledge transfer process through engagement in both the university and industry communities. By illuminating the dimensions of the inter-personal interactions the CoPs analysis provides the foundations for recommendations to improve university-industry KTPs, in particular, and, inter-organisational knowledge transfer initiatives in general.

University-Industry Collaboration: A CoPs Approach to KTPs

1. Introduction

As producers of knowledge, universities make an important contribution to the economy through their support for innovation (Mansfield, 1991; Kitson, *et al.*, 2009). Interaction between academia and external organisations can facilitate the transfer of knowledge and even stimulate the production of new knowledge. However, a key challenge centres on understanding and facilitating this knowledge transfer process (Bjerregaard, 2010; Boardman and Ponomariov, 2009). In seeking to understand how university knowledge is applied in industry to support innovation, much emphasis has been placed on patent licensing and other easily measurable forms of university-industry linkage yet it has been argued that a wider range of channels for interaction exist (Agrawal, 2001) and that understanding relationships in depth may be necessary to better understand the knowledge transfer and innovation process (Perkmann and Walsh, 2007). By exploring knowledge interactions at this micro level it will be possible to reveal the factors contributing to successful university – industry knowledge transfer schemes.

In a comprehensive review of UK university-industry collaboration Lambert (2003: 31) identifies human interaction as one of the best forms of knowledge transfer. One such mechanism available in the UK is the Knowledge Transfer Partnerships (KTP) programme, previously known as the Teaching Company Scheme (TCS), a government sponsored scheme that brings together individuals from academia and industry through the establishment of a collaborative project lasting 12 -36 months. Although empirical evidence suggests that KTPs are successful (Lambert, 2003: 27) there is, as yet, little conceptual analysis or understanding of how the knowledge transfer process occurs within the partnership. How is knowledge exchanged through the personal interactions arising from the KTP? As knowledge exchange can be seen as a form of learning, this article seeks to address this question by examining the detailed processes of knowledge flow and learning within KTP projects through the lens of the communities of practice (CoPs) approach to situated learning. Moreover, by demonstrating the value of the CoPs framework as a means of surfacing the dynamics of knowledge transfer in KTPs, the article offers a conceptual framework which could be applied to understanding other forms of knowledge transfer between universities and firms, such as collaborative research, training programmes and information provision.

Originally developed by Lave and Wenger (1991) in a study of situated learning in apprenticeships, the CoPs approach has since been used to analyse and facilitate knowledge transfer in a wide variety of inter and intra organisational environments (Amin and Roberts, 2008). Emerging initially from studies of knowledge sharing in individual organisations such as an insurance claims office (Wenger 1998) or Xerox (Brown and Duguid, 2000) the approach has also been applied to inter organisational learning and knowledge dissemination activities within, for instance, professional communities (Faulconbridge, 2007; Roberts, 2010) and on-line communities (Ardichvili, *et al.*, 2003). The value of the CoPs approach lies in its focus on the interactions between community members as they engage in their everyday work practices. Brown and Duguid (2001: 200) refer to practice as the 'way work is done', and a growing emphasis has been placed on practice as a locus of learning and knowledge transfer (Gherardi, 2006). Moreover, the idea of community captures the social context within which interdependent individuals working together develop shared identities and, in so doing, cultivate the mutual understanding that underpins knowledge transfer (Roberts, 2000).

The nature of university-industry knowledge transfer is outlined in the next section providing the context for the overview of the KTP scheme that follows. The CoPs approach and its value in exploring inter and intra organisational knowledge transfer in KTPs is then outlined before the research methods employed in the empirical study are briefly reviewed. The three KTP case studies are then presented before the knowledge interactions identified in these KTPs are analysed through the CoPs approach. The results of the analysis are discussed and implications considered, including directions for further research, before conclusions are drawn in the final section.

2. University-Industry Interactions

University-industry links have spawned a huge literature in recent years and have occupied considerable policy interest, based on the expectation that university knowledge and technologies can have significant economic impact (Mansfield, 1991). However the expectations of policymakers that knowledge and technologies will flow from universities to be implemented in innovation in firms are frequently naïve. The degree of impact of university activities on industrial innovation and the nature of the linkage used depend on the industry concerned, as well as the provision of appropriate policy for knowledge transfer. Industrial sectors and technologies have differentiated dependence on scientific knowledge; some such as biotechnology have a very close relationship with the development of new scientific knowledge whilst others are rooted much more in established knowledge and industrial techniques which are not a primary interest of universities. Individual firms also have differentiated orientation to academic partners, with some having strong historic links whilst others focus their partnerships on other firms and non-academic organisations. The existence of university-industry links and the success of policy to encourage knowledge transfer will therefore depend on these attributes of industries and firms as well as policies of universities and governments.

Much policy attention has become fixed on inventions and intellectual property (IP) (Fini *et al*., 2010), perhaps exemplified in the term technology transfer which is increasingly falling out of favour. This focus on technologies and codified knowledge has been overstated because university – industry knowledge transfer spans a much broader range of interactions including formal (cross-licensing deals, research collaborations and joint ventures), informal collaborations (personal interactions) and focused and non-focused or general support (Charles and Howells 1992: 26 and 27). The term knowledge transfer or even knowledge exchange has therefore become more prominent in both academic and policy discourses to recognise that the needs of innovation in the firm are not restricted to discrete technologies, but encompass a variety of kinds of knowledge including social and managerial knowledges which may be essential to the exploitation of technologies.

There is an increasing recognition that knowledge transfer operates through a variety of channels dependent on the characteristics of knowledge and range from formalised transfer of codified forms of knowledge such as publications and patents to informal discussions, collaborative research and the movement of people (Schartinger *et al*., 2002). Much academic interest has focused on the more formal channels such as patents as these are more easily observed and measured, but Agrawal (2001) stresses the importance of non-codified knowledge channels and the need for more research on the mechanics and characteristics of such channels. These may be particularly important in industries without a strong patenting culture. A key dimension of such informal linkage is the degree of intensity of relationship, for it has been shown that social links and relationships are central to successful knowledge transfer in various forms of network and alliance (Perkmann and Walsh, 2007, 260). Indeed it

is suggested that firms look to 'capacity building and learning rather than tangible outcomes' in their collaboration with universities (Perkmann and Walsh, 2007, 272), which suggests patents would be a minor form of exchange.

Despite the interest in university-industry knowledge transfer, firms themselves usually rate universities as being of low importance as a source of knowledge for innovation (Hughes, 2008). Evidently there remain considerable barriers to effective university-industry knowledge collaboration. For instance, Bruneel *et al.* (2010) stress the importance of different institutional norms between universities and firms, as well as conflicts over IP. Academics generally work within "Mertonian norms of science, such as communalism, universalism, disinterestedness and organized scepticism (Merton, 1973)" (Bruneel *et al* 2010, 859). The open nature of science contrasts with the more closed and protective approach of industry, and despite movement on both sides to a more mixed culture, attitudinal alignment between firms and universities remains a problem. A growing interest of university administrators in IP protection and exploitation also raises barriers as over-optimistic valuations may be placed on university IP.

Close collaboration may help to overcome these barriers, notably by 'learning to share common norms' (Bruneel et al, 2010, 860). Close relationships, fostered by staff mobility between academic and industrial contexts (Perkmann and Walsh, 2007), can help to build trust to address the inherently high levels of uncertainty in knowledge transfer. This may be especially important given the sensitivity of knowledge about the firm and its strategy revealed through the innovation process.

The importance of tacit knowledge at the heart of firm-specific advantage (Grant, 1996) implies that effective knowledge transfer needs to have a strong tacit component. While codified or explicit knowledge can be transferred across time and space embodied in tangible forms, including operating manuals, software and patents, tacit knowledge transfer involves a process of demonstration and learning by doing (Roberts 2000; Arrow, 1974). As a result, tacitness gives knowledge a sticky quality (Szulanski, 2003) making it more difficult to transfer.

The acquisition of tacit knowledge must then be seen as a process of learning. Academic partners need to share some of this tacit knowledge to participate in collaborative research: more intense forms of collaboration, especially those with exchanges of staff, will have a higher tacit component. Studies related to this type of university-industry knowledge transfer include those considering the implication of university-industry research/linkages (Blumenthal *et al.*, 1986; Mueller, 2006; Este and Patel, 2007; Arvanitis *et al.*, 2008) and those comparing the UK's Teaching Company Scheme (TCS) with other technology transfer schemes (Acworth, 2008; Burvill and Leary, 2001). However, these studies tend not to develop a conceptual framework to examine the nature of knowledge transfer as a learning process – an omission which this article is seeking to rectify.

3. Knowledge Transfer Partnerships

The TCS was established in 1975 based on the idea of knowledge transfer through 'learning by doing' (Peattie, 1993). Developed in an era characterised by university supply-led knowledge transfer, the TCS was relaunched and renamed as the KTP in 2003 to reflect the present day demand-led nature of university-industry knowledge interactions 'driven by the interplay between the suppliers and receivers of knowledge' (Giudice *et al.*, 2008: 338). The

long-term effects of the best programmes can be characterised as inducing extensive organisational learning through the establishment of good working relationships facilitating knowledge transfer (Senker *et al.*, 1993). Despite the success of the KTP scheme it remains unique to the UK.[1] Outside the UK there are other types of university-industry knowledge transfer programmes, and their success may account for the failure of the KTP scheme to spread beyond the UK.[2]

A KTP consists of a collaboration between three partners: an academic - often referred to as the knowledge base partner, a recent graduate - the associate, and a member of the collaborating organisation - the company partner, which may be a private or public sector organisation. The scheme focuses on bringing benefits to both industry and academic institutions through knowledge transfer between the three partners.

The main objectives of the scheme, as stated by the official KTP website, are to:

- "Facilitate the transfer of knowledge and the spread of technical and business skills, through innovation projects undertaken by high calibre, recently qualified, people under the joint supervision of personnel from business and the knowledge base
- Provide company-based training for graduates in order to enhance their business and specialist skills within the context of the project
- Stimulate and enhancing business relevant education and research undertaken by the knowledge base
- Increase the extent of interactions by businesses with the knowledge base and their awareness of the contribution the knowledge base can make to business development and growth" (KTP, 2010).

The KTP scheme is structured to promote collaborative interaction in which the three partners work together to reach the objectives of a specific business project. The central component of a KTP is the associate partner who is employed by the university and spends 10% of their time on formal training and 90% of their time based in the company. As a result, the associate acts as the human bridge linking the academic and the industrial partners (Tiler and Gibbons, 1991). Charged with the task of driving the project forward, the associate acts as a change agent within the company and is supported by the academic and company partners (Peattie, 1993). By acting as a 'bottom up champion' the associate is central to convincing the company's staff of the need for change as well as directing, managing and delivering the project (McGovern and Hicks, 2004: 248; Day, 1994). The associate is expected to communicate the results of their work to both the academic and the company partner. In this way the associate acts as a conduit of new, though culturally customised, knowledge to the company (Senker and Senker, 1994).

The university partner contributes academic knowledge to the partnership, spends ½ a day per week in the company partner's organisation and provides guidance for the associate. In return, the practice-based knowledge gained from the company partner, and, more broadly from participation in the project, can be employed in the research and teaching activities of the academic partner. The company partner provides the business problem, the day-to-day project control and supervision of the associate, and is the primary recipient of the knowledge transfer process.

[1] The TCS was introduced in Australia during late 1980s. However, despite positive reviews, it did not survive beyond the early 1990s (Bureau of Industry Economics, 1991).

[2] Countries such as the United States already had their own university-industry programmes in place around the same time the TCS was established (NSF, 2010; see also Gray and Walters, 1998).

KTPs benefit a wide range of organisations from micro sized, small, medium and large businesses to third sector and public sector organisations (KTP, 2010). They offer several benefits for the company partner seeking to engage in a change process, including access to a qualified graduate, access to academic knowledge at an affordable price, and innovative solutions to increase profitability and business performance (KTP, 2010).

The business partner and the Technology Strategy Board (TSB), in conjunction with 19 other funding organisations, including research councils, government departments, devolved administrations, regional development agencies and the European Social Fund, jointly fund KTPs. During 2008/09 the KTP portfolio comprised 977 projects across a full range of organisation size (KTP, 2009: 8). Although KTPs initially involved partnerships mainly between manufacturing companies and university engineering departments, they now involve companies from every sector and a more varied range of university departments (Robson, 1996; KTP, 2009). The expected average business benefit from a single KTP project includes an increase of over £227,000 in annual pre-tax profits, the creation of three new jobs, in addition to the associate, and, an additional 14 staff trained (KTP, 2009: 7). The current average annual cost of a KTP project is £60,000 with the contribution of the business partner varying according to its size and the number of KTP projects undertaken. For example, a small to medium sized enterprise would, on average, contribute £20,000 per annum (KTP, 2010).

Although there are a number of other highly successful schemes (CASE studentships,[3] collaborative research projects, and fellowships) that have facilitated university-industry interaction, according to Howells (2000), such schemes have mostly focused on postgraduate research and training with graduates being firmly embedded in the university culture.[4] In contrast, KTP graduate associates are more integrated into the company culture. With its focus on personal interaction between the three partners, the KTP scheme is very much concerned with the transfer of tacit knowledge through a process of learning (Tiler and Gibbons 1991: 49). Indeed, Senker *et al.*'s (1993) study of the KTP scheme found a significant correlation between the quality of partner relations and the successful transfer of knowledge.

Despite evidence indicating that the knowledge transfer process in KTPs is underpinned by the interactions between the partners, these interactions remain under researched, and, therefore, poorly appreciated. Through the adoption of the CoPs framework as an analytical lens this article seeks to shed light on the interactions between KTP partners as a means of facilitating knowledge transfer through the process of situated learning. The strength of the CoPs approach is its focus on the social and practice-based interaction at the heart of the learning process. This provides particular value for the development of a detailed understanding of the knowledge transfer process in KTPs. Exploring the relationships and social interaction that occurs in KTPs through the lens of the CoPs approach offers opportunities to reveal the micro-dimensions of the learning and knowledge transfer process as well as the factors contributing to successful university – industry knowledge transfer schemes. Before progressing it is necessary to develop a deeper appreciation of the CoPs approach.

[3] Collaborative Awards in Science and Engineering.

[4] For an in-depth comparison on how similar programmes work see Acworth (2008: 1245).

4. A Community of Practice Approach to KTPs

In their seminal study of situated learning Lave and Wenger (1991: 98) defined a community of practice as 'a system of relationships between people, activities, and the world; developing with time, and in relation to other tangential and overlapping communities of practice'. Relationships and social interaction are seen as central to knowledge and learning in communities that coalesce around specific practices. Participation in the community, initially as a legitimate peripheral participant, gives members access through learning to the community's knowledge resources as well as the ability to participate in the negotiation of meaning within the community.

Studying insurance claims processing, Wenger developed a detailed understanding of the dynamic operation of CoPs focusing on the social interactive aspects of situated learning. He identified three dimensions of the relation by which practice is the source of coherence in a community (1998: 72-84). Firstly, members interact with one another, participating in a particular practice together, establishing norms and relationships through *mutual engagement*. Secondly, members are bound together by an understanding of a sense of *joint enterprise*. Finally, by negotiating meaning through a process of participation and reification[5] members produce over time a *shared repertoire* of communal resources, including, for example, language, routines, artefacts and stories.

Through participation members come to identify with the community. Furthermore, Wenger (2000: 227-8) distinguishes between three modes of belonging to social learning systems. Firstly, *engagement* is achieved through doing things together, for example, talking and producing artefacts. Secondly, *imagination* involves constructing an image of ourselves, of our communities, and of the world, in order to orient ourselves, to reflect on our situation, and to explore possibilities. Finally, *alignment* involves making sure that our local activities are sufficiently aligned with other processes so that they can be effective beyond our own engagement.

Wenger (1998) found that new members of insurance claims processing department became claim processors as they learned and develop their skills in participation with other members of the community. Therefore, as Wenger (1998: 153) argues 'membership in a community of practice translates into an identity as a form of competence'. In this way, a newcomer moves from a position of legitimate peripheral participation to full participation. Identity and practice are then intimately connected. It is, however, important to recognise that the identity of an individual is a nexus of multi-membership. Individuals must reconcile their various identities as, for example, employees, mothers and part-time students.

Although newcomers are gradually absorbed into existing practices, it is important to recognise that CoPs are not static entities with new members merely learning to replicate a specific set of knowledge. As members, new and old, engage in an ever-changing world they gain new experiences that inform their understanding of practice and shape the meanings that they negotiate through participation in various communities. Consequently, meaning is constantly being negotiated and renegotiated and in the process new knowledge is developed and old knowledge discarded. Newcomers can have a particularly important role in the development of new knowledge in a CoP because they bring with them new resources and

[5] Wenger (1998, p. 58) refers to the term reification as 'the process of giving form to our experience by producing objects that congeal this experience into "thingness"'. Examples of reification include the production of abstractions, concepts, symbols, tools and stories. This process of reification contributes to the development of a shared repertoire.

fresh perspectives. In this way, new members can be a potent means of introducing new knowledge into a community and thereby facilitating a knowledge transfer process.

In addition, CoPs should not be viewed in isolation, for they may interact and overlap forming constellation of related practices (Wenger, 1998). According to Wenger (1998) when a social configuration is viewed as a constellation rather than a CoP, the sustaining of the constellation must be maintained in terms of interactions among practices involving boundary processes. These interactions offer further opportunities for CoPs to absorb new knowledge from which alternative meanings may be negotiated. Wenger (1998, 2000) identifies a number of boundary processes through which knowledge can be transferred including brokering, boundary objects, boundary interactions and cross-disciplinary projects.

For instance, brokers through their boundary spanning activity introduce elements of one practice into another taking care of one specific boundary at a time (Wenger, 2000). Tushman and Scanlan (1981) suggest that boundary spanning involves obtaining information from outside units and disseminating this information to internal users: this requires learning the local coding schemes and languages on both sides of the boundary thereby developing the capacity to span the boundary effectively. The boundary spanner must achieve a high degree of alignment with the identity of the recipient.

Where boundary practices, overlaps, and peripheries are identified the role of marginality becomes significant (Star and Griesemer, 1989). New members of a community may be peripheral participants only becoming full participants once they have gained knowledge and understanding of the activities of the community. Some members may retain a peripheral status and be engaged in a number of communities. Members of multiple communities can act as brokers between different CoPs. Although, as Mutch (2003: 397.) argues, 'multi-membership is not necessarily a resource that translates into different perspectives' or indeed into the ability to adopt multiple perspectives. Nevertheless, elements of styles and discourses, including language and the way it is used, metaphors, types of narratives, ways of presenting information, manners, behaviour, and so on, can be imported and exported across boundaries, and reinterpreted and adapted in the process of being adopted within various practices (Wenger, 1998: 129).

Despite criticism of the CoPs approach based, for instance, on its failure to fully account for power relations, its lack of specificity and inadequate explanation of the dynamics of learning, (Fox, 2000; Contu and Willmott, 2003; Mutch, 2003; Roberts, 2006; Handley, *et al.*, 2006; *inter alia*), it retains a number of advantages when analysing the learning and knowledge transfer within the context of KTPs. First, it acknowledges that practice is an intrinsic condition of the existence of knowledge. In this respect it 'recognizes the situated and "purposive" nature of knowledge as it is created by a community of individuals who have a shared practice or problem and share in its consequences' (Carlile, 2002: 445). Second, CoPs are significant arenas for the reproduction, evolution and diffusion of knowledge (Brown and Duguid, 2001). Third, the CoP framework not only provides a mechanism with which to analyse the production and exchange of knowledge within a particular community, but also how this knowledge is disseminated across communities (Roberts, 2010). Finally, by conceptualising the interactions that occur within the KTP company and university as taking place in CoPs, rather than in formal departments, teams or working groups, the approach captures the elements that underpin social interaction in communities, namely, trust and relations of mutuality. These features that are not always present in formal structures (Lindkvist, 2005), which are characterised by transactional rather than social relations (Amin and Cohendet, 2004). Moreover the boundaries of CoPs are not synonymous with those of formal organisational structures (Roberts, 2006).

But how can we apply the CoPs approach to the KTP? What CoPs exist within the context of a KTP project? How do members of a KTP project interact with such CoPs? To address these questions it is necessary, firstly, to identify the relevant CoPs, and, secondly, to consider how the various KTP partners engage in these CoPs to achieve their project objectives.

Firstly, then, we need to identify the communities that have some involvement in the KTP project. Within any organisation there will be CoPs, although these may not align with the formal organisational structure, or be reified to their members. It would be wrong to suggest that every department, project group or team displays the characteristics of a CoP. Even so, organisations may, to a greater or lesser extent, be conceptualized as constellations or networks of practice (Brown and Duguid, 1991, 2001; Wenger and Snyder, 2000). Universities are, for example, constructed from a range of discipline based departments as well as operational departments and research centres – each of which may include groups that, to some extent, display the characteristic of a CoP. The company may be similarly conceived, although the size of companies engaged in KTPs varies substantially from large multinational businesses to small locally based companies and consequently the number of CoPs sustained within the boundaries of the company will vary. Company and university partners will belong to a variety of CoPs both within and beyond their own organisation. Like the company and university partners the KTP associate may be viewed as belonging to a variety of CoPs.

Secondly, the roles of the various partners in the project differ in relation to how they interact with the communities touched by the KTP project. The associate, as the only partner employed full-time on the project, has a central role. Through the KTP project the associate gains a legitimate role in both the company and the university communities. An examination of the role of the KTP associate in the various CoPs engaged in the project provides an understanding of the knowledge transfer process. Spending the majority of their time in the company organisation, the associate begins the project as a legitimate peripheral participant in the CoP formed around the KTP project in the company partner. As they develop competence as a member of the organisation the associate comes to identify with the company CoP. In this process they move from a legitimate peripheral participant to become a full participant in the community. Through the daily practice of interacting in the company CoP the associate is able to contribute to the shaping of practices through participation in the negotiation of meaning. In this way, they influence the community's knowledge base and introduce new knowledge. This new knowledge will be adapted and given fresh meaning as it is absorbed into the community context. The knowledge transfer process is not a direct replication of knowledge from one context to another - it will be mediated and often contested. Hence, the skills of the associate in aligning their identity with that of the company CoP will underpin the success of the knowledge transfer process.

Of course, the associate is also a participant in the academic community. Although this is less significant in terms of time commitment, it is no less important to the overall success of the project. The associate will be actively engaged in the research project linked to the KTP and they may be enrolled on a postgraduate degree programme. The associate can therefore also be conceptualised as a legitimate peripheral participant in the academic community. Yet, their position is somewhat marginalized in the sense that their time for academic engagement is more limited and the whole purpose of the KTP project is to achieve a practical objective for the company partner. Nevertheless, their engagement will be important in terms of absorbing knowledge to facilitate the achievement of the project's objectives in the company partner. The degree to which the associate becomes a full participant in the university

community may depend to some extent on whether they wish to pursue an academic career. They will most fully participate in the negotiation of meaning in the research grouping associated with the KTP project.

Over time the KTP associate becomes more embedded in the two very separate CoPs. In the process the associate develops dual identities and competencies, thereby acquiring the skills to translate meanings between the two contexts. In this way, the KTP associate acts as a conduit for knowledge transfer between the university and the company.

Finally, the role of the company and academic partner require consideration, for instance, are they legitimate peripheral participants in each community, or, are they knowledge brokers engaging in boundary spanning activity? It is often the case that the university partner will have experience linking with the industrial partner prior to the establishment of the KTP project. The academic partner, through their ongoing research activity, may already act as a boundary spanner between the university and the company. As such the company partner may also have links with the university – perhaps through previous contact with the academic partner or through engagement in postgraduate degree programmes. A range of boundary interactions may link the company and the university including joint research or consultancy projects. Given that the academic and the company partners are centrally involved in their primary organisation, their capacity for participation in the partner organisation is somewhat limited and usually confined to a marginal role as a broker and boundary spanner or, at most, a legitimate peripheral participant.

[INSERT FIGURE 1 HERE]

Figure 1 seeks to capture the interactions that make up the KTP partnership by showing industry and academic partners as members of CoPs within their own organisations and the associate as gaining membership through the adoption of a dual identity and ability to participate competently in both CoPs. Although the company and university partners are embedded in CoPs within their own organisations, they do reach across into the CoPs of the partner organisations through their role as brokers and their boundary spanning activity.

Does the explanatory value of the CoPs approach extend beyond theory and into practice? To explain the knowledge transfer process in KTPs and assess the value of a CoPs approach it is necessary to analyse the evidence. Prior to this, the research methods are briefly elaborated in the next section.

5. Research Methods

A multiple case study approach involving three separate KTPs projects spanning from 2007 – 2010 was undertaken. This approach was utilised as it offered insight into the complex social processes of the knowledge transfer process which quantitative data could not easily reveal (Eisenhardt and Graebner, 2007). The advantages of this research approach include “the potential to generate theory with less researcher bias than theory built from incremental studies” (Eisenhardt, 1989: 546) and “the likelihood that resultant theory will be empirically valid” (ibid:547). Additional advantages comprise the richness of case studies, data source variety (Yin, 1994) and the flexibility for the researcher to come closer to constructs and to

illustrate causal relationships more directly (Siggelkow, 2007). Weakenesses of the approach include over theorising and the lack of generality of the theory (Eisenhardt, 1989).

The multiple cases selected were taken from the KTPs main public database where all KTPs are listed. Multiple cases characteristically offer a stronger base for theory building (Yin, 1994), and "yield more robust, generalisable and testable theory than single-case research" (Eisenhardt and Graebner, 2007:27). From this data, three dissimilar case studies were chosen on the basis of theoretical sampling to investigate the social interaction between the KTPs partners facilitating the knowledge transfer process (Eisenhardt and Graebner, 2007). Key criteria utilised in the selection process included: KTP organisational diversity; partnership time frame; size in terms of number of employees; knowledge/technology; industries/sectors – with one public sector organisation and two private firms; and the partnership objectives. The three dissimilar case studies provided the foundation for a comparative analysis to ensure that results would be more representative as well as to capture knowledge transfer at various timeframes within various KTPs.

Empirical evidence concerning the operation of the KTPs was collected through semi-structured interviews with the three KTP actors (academic, associate and company partners) in each case study. These KTP partners represent key individuals involved in the KTP partnership and were specifically chosen to shed light on the personal interactions arising from the KTP and the broader context providing an in-depth understanding of the knowledge transfer process (Gaskell, 2000). A total of nine interviews with KTP partners (three KTP partners across each case) were conducted each lasting approximately 60-90 minutes. The interviews were conducted over a four week period and the time gap between each interview was less than a week. In addition, broad contextual information was gathered through four further interviews, conducted with members of public sector organisations that support and fund KTPs, and the review of relevant documentary material. The additional interviews were conducted to limit bias and to gain valuable insights and diverse perspectives from highly knowledgeable informants (Eisenhardt and Graebner, 2007). The case study approach characteristically joins data collection methods such as archives, interviews, questionnaires and observations (Eisenhardt, 1989).

Interview questions sought to examine the dynamics of the interaction between the partners as they worked towards reaching the KTP objectives. Open-ended questions were utilised to identify not only how the interviewee sees their relevance to the specific questions, but also how he/she defines their own identity in relation to the questions (Gubrium and Sankar, 1994). Because of the comparative nature of this study and in order to surface the differences between the three case studies, three sets of questions were developed one for each of the three types of KTP partners. The standardisation of question and the recording of answers reduced the error of interview variability (Bryman and Bell, 2007).

The data was analysed using the framework approach, an analytical method of qualitative data analysis which involves a systematic process of familiarisation, identifying a thematic framework, indexing or coding, charting, mapping and interpretation according to key issues and themes. Framework was chosen as it is in line with the agreed methods within the case study-based research approach including familiarisation, searching for cross-case patterns and emerging theory (Eisenhardt and Graebner, 2007). One of frameworks key features is it allows between – and within – case analysis (Ritchie and Spencer, 1994)

The first step in the analysis involved identifying a thematic framework informed by the original research aims, emergent issues raised by respondents themselves, analytical themes arising from recurring views or experiences and the CoP literature (Eisenhardt and Graebner, 2007). The second step included 'indexing' or 'coding' whereby the thematic coding was

systematically applied to the data by a numerical system which links back to the index categories. These categories emerged from the CoPs literature and are listed in Appendix 1.

Intracoder reliability was ensured through the establishment of discrete dimensions, mutually exhaustive categories, a clear process on how to interpret each dimension and a clear unit of analysis (Bryman and Bell, 2007). Intercorder reliability was also designed to include multiple researchers (Neuendorf, 2002). The initial coding was reviewed by one author multiple times and was then evaluated by a second author. The third step in the analysis involved 'charting' where coded data was 'lifted' from the original transcripts and arranged according to the appropriate thematic reference by individual case study. A chart was created for each case study to ensure themes within cases were always kept in the same order and to allow for the easy comparison between cases (Ritchie and Spencer, 1994). Finally, explanations were sought in order to address the core research question - How is knowledge exchanged through the personal interactions arising from the KTP? - as well as to account for patterns of behaviour that arose from the research. This approach provided a means to research in-depth the way social learning and knowledge transfer occurs through the KTP scheme.

6. Case Studies

The three KTP case studies involved university engagement with the following organisations: a Community High School (CHS); a Windows and Cladding Systems Firm (WCSF); and, a Design and Engineering Firm (DEF). All original case names are anonymised. Details of the key features, partnership objectives, partner inputs and partner outputs of each case are provided in Table 1.

[INSERT TABLE 1 HERE]

Despite the diversity in the cases studied, similar themes emerged. Firstly, all the KTP projects developed from an organisation's unmet need to expand structural capacity or markets. In the case of the school, expansion involved moving from a satisfactory teaching level to outstanding. Prior to joining the KTP, the companies understood that internal resources were lacking and turned to the University for guidance. Secondly, all academic partners had a broad range of industrial experience and knowledge. Thirdly, a strong commitment to the associate was also seen throughout all three cases. In one case, the associate was seconded to sit on the leadership board of the high school to be able to effectively make changes suggested by the KTP project. Finally, over time all partners understood their individual objectives as well as the objectives of the KTP project.

7. The Community in the KTP

The analysis of the three case studies provides evidence to support the value of conceptualising the process of knowledge transfer between universities and industry as one of learning taking place within communities in which the development of mutual engagement, joint enterprise and shared repertoires play important roles facilitating successful

collaborations. Importantly, the evidence underlines the role of the KTP associate who through personal interaction with members of both the company and university communities acts as a key facilitator of knowledge transfer. By becoming a participant in both the company and university communities the associate adopts a dual identity and is thereby able to engage in the shaping of meaning in both communities. It is in this process of shaping meaning that the associate becomes a conduit for knowledge transfer and is able to undertake the tasks required to successfully achieve the KTP project aims and objectives. This section begins by reviewing the evidence of the role of the associate within the company and university communities. The interactions between the partners in the KTP project are then considered.

7.1. The KTP associate: From legitimate peripheral participant to full participant

Many studies of CoPs focus on knowledge at the heart of the community and how peripheral individuals are gradually absorbed into the community. However, this study highlights the role of the associate as a trusted member of both the university and company communities and the importance of their ability to adopt a dual identity with the capacity, for example, to become competent in the use of two styles of language and to translate meaning between the two contexts with ease. In particular, the associate not only acts as broker or boundary spanner bridging between the university and the company, but also becomes a competent member of both communities. However, the process of becoming a member takes time and is dependent upon the associate's ability to adapt and to negotiate between various disparate identities.

7.1.1. Company community

In the KTPs examined there was evidence to suggest that the integration of the associate into the company is a gradual process. The associates talk about settling in and of developing a rapport with the company, a process that is often facilitated by the company partner and taken into account in the planned scheme of work. The associate becomes part of the organisation through participation in specific groups in the organisation and through attendance at regular departmental meetings and company-wide training courses. For instance, as the DEF KTP Associate explained:

> "I would say that I do sort of feel more at home because of the sort of effort that's been made to sort of integrate me into the department and obviously getting to know the people but being here has helped in that as well. I think it is mainly sort of if you get integrated into the work place you will feel at home and then if you are included in things and of course what everyone else is doing in fact that was one of the ways I think that really helped was when I arrived there was a course going on in the whole company. I was on that as well – again you get to know people a lot quicker when you are sort of interacting with them more."

The company partner plays an important role providing the associate with legitimate, though initially peripheral, participation in the company organisation. Over time a trusting relationship develops between the associate and the company partner. The associate gains an understanding of the company context and becomes increasingly influential in the

development of the project. As one company partner elaborates on the integration of the associate into the organisation:

> "She has been prepared to be the person to expose her frailties, interests, concerns and so she bought a ticket to be an equal member of the club. And working hard I think is another thing that is really part of it. She has been based in school sort of 80% so that has meant that she is identified as a member of the school community and I think staff would be really impressed with her relationships with pupils. I think that gets her a little street cred amongst the teachers that if you have got that quality of relationships with the kids then you are part of, you get membership. I think people also feel that she is bringing something valuable. She is adding something that they don't have." (CHS Company partner)

For some company partners the associate is very quickly regarded as just another colleague. This was especially the case in an organisation that has many ongoing R&D projects. In such contexts the KTP project is one among many projects and therefore the mode of working aligns easily with that of the organisation. In other cases there is a greater need for the associate to adapt and align to a new and varied company culture:

> "I find sometimes it is a bit brash. Sometimes the people I am talking to on the shop floor right to the managing director so I have to word things in the right way to the right people. So I can understand the culture of the workforce and I can understand the management so I can identify sort of."(WCSF KTP Associate)

However, the efforts of this particular associate to align their language with those in the company certainly advanced the process of becoming a full participant in the company community, as the company partner explains:

> "… he started looking at things in a more business-like manner than he ever did before. Before at the beginning he was all about his education, it was number one, number two and number three. Now it is important to him … how well the company does …. So we are obviously spending a lot more time with him because we have got him to a really good position really within the company. How can I say this? We value him a lot more now as he has started to talk and act like he is working for the company rather than an outsider so we feel that he deserves more and time and effort from us because of it." (WCSF KTP Company partner)

The development of a similar worldview, which was a key turning point for this company partner, allowed the company members and associate to better share information and increase their personal interaction. Here the KTP associate adopts a business style discourse to communicate effectively with the company members. This business discourse can be viewed as part of the company's shared repertoire. Through demonstrating familiarity with the appropriate business language the associate demonstrates his mutual engagement in the joint enterprise of the company community. He takes on the company identity and becomes a full participant in the community.

As the associate's identity, and, with it, their interests become aligned with those of the company they become more integrated into the organisation. The associate becomes a valued member of the company community. In this way the associate moves from legitimate

peripheral participation towards full participation gaining an increased capacity to participate in the negotiation of meaning within the company context. Through the negotiation of meaning the associate is able to shape community practices bringing knowledge from outside the community, combining it and developing new understandings, creating and transferring knowledge in the process.

However, to achieve this, the associate does have to adopt the appropriate identity and the speed with which this can be accomplished depends on the associate's existing skills and the support provided by company and academic partners. In the three KTP projects studied there were clear differences in the initial abilities of the KTP associates to integrate into the partner communities. This appeared to be partly attributable to differences in personality, including leadership qualities, previous experience and level of maturity. Nevertheless, over time they all successfully developed a capacity to adopt the identities required to successfully achieve the project objectives. Failure to develop a dual identity will result in the associate remaining on the periphery of both the company and academic community thereby reducing the scope for successful knowledge transfer and the achievement of the KTP project objectives.

Consequently, for the associate there is a level of tension in developing a dual identity as both a company member and an academic. Moreover, as a member of the KTP the associate is responsible for delivering outcomes that often involve a degree of change for existing community members. Therefore the associate must carefully balance the various demands by developing a capacity to identify with, yet simultaneously retain a certain distance from, the community. As Nooteboom (2008) suggests, a degree of cognitive distance is required to maintain the capacity for creative interaction. Yet where cognitive distance is too great the ability of individuals to engage in constructive communication is impaired. For example, the associates found it necessary to avoid projecting an academic identity, including the use of academic language, in the company context as this undermined their ability to communicate with company members. As one associate clearly explained the need to adopt a distinct mode of communication when interacting with the company partner:

> '….misunderstandings are more on my part with him because I talk to him in academic jargon lalalalalala saying three hundred words that you can say in 10 and I just have to be aware that when I am with John [Company partner] I am in John mode and when I am with Jack [Academic partner] I am in Jack mode and I just have to be aware of my audience and try and amend the way that I am, adjust the way that I am accordingly similarly with kids you can't talk with students in school the same way you can talk to staff so it is moving in and out of different modes all the time." (CHS KTP Associate)

Adapting language styles between the various communities is facilitated by the cultivation of two distinct identities between which the associate learns to switch with ease. All the associates interviewed recognised the differences between the company and the academic context and the need to adapt to each in different ways.

7.1.2. Academic community

All three of the associates interviewed appeared to find the academic environment more familiar and they were more able to identify with academia from the very start of the project. This is not surprising given that they were all graduates or postgraduates, having spent time in university contexts, and as part of the KTP project they are engaged in related postgraduate degree programmes or research projects. However, as with the integration into the company,

full integration into the academic community may also occur on a gradual basis for those that had been away from the university environment for some time. This was the case for the DEF KTP associate, as the academic partner explained:

> "We tried to slowly introduce him into the field not into the deep end so he got the basic knowledge, little projects mainly to start reading again, reading scientific papers, writing resumes of what he read to see whether he understood and we started you know let's say softly softly approach for the first three months …. So I would think after month 6 he started feeling a bit more confident."

Moreover, in the initial stage of the project it is necessary to give particular effort to the company to get the project off the ground, and throughout the project the associate spends the majority of their time in the company context. Consequently, a gradual integration into academia may be necessary.

Despite less time being spent in the university context, across all three case studies there was evidence of the KTP associate being absorbed into the relevant university community. One academic partner clearly articulates this:

> "She is completely accepted in equal status so that means I can just treat her as part of the research centre. She is that well embedded/accepted and part of that is coming through as she has done bits of teaching for us, we have done conference presentations. She has represented the research centre so I think she has done a lot to win the confidence of people within the research centre, she has been part of research bids that other RAs [Research Assistants] would do. It was helped by the fact that she was an Ed D [Education Doctorate] student already so she had a bit of history and started off as an M Ed [Master of Education] student and then progressed on to the Ed D so she knew a few people through that." (CHS Academic partner)

Through the development of their competence as an academic the associates were able to absorb knowledge and negotiate meaning in their academic environments. This knowledge could then be used in the company community. Consequently, the associates were centrally involved in the knowledge transfer process. By adopting a dual identity and spanning across the university and company communities they were able to broker the knowledge exchanges, translating the meaning of knowledge and ideas, between their collaborators in both communities. Moreover, through drawing on their individual skills and personal qualities the associates were able to improve their employability, develop professionally and collect industrial contacts during the KTP projects.

7.2 The KTP project: as a community

Although the associate partners are vital for the success transfer of knowledge, they are not the only conduits of knowledge within the KTP. Through their support of the associate, both the company and university partners engage in knowledge transfer. This occurs within the KTP project team as it takes on the qualities of a purposively constructed CoP.

Mutual engagement between the partners was essential for the establishment of the KTP projects. Through regular contact the partners came to identify themselves with the KTP project, and, shared ways of engaging contributed to the development of collaborative practices in all three case studies. Meetings were emphasised in all cases as places where members where physically 'co-located'. This face-to-face interaction facilitated a rich flow of

knowledge between all partners with the aim of progressing towards the achievement of the KTP project objectives.

The KTPs partners interviewed clearly saw themselves as engaged in a joint enterprise with the other members of the project. The partners negotiate not only their daily practice but also their roles in a larger context. Through participation in the joint enterprise partners constructed and negotiated shared meanings over time that enabled knowledge transfer within their KTP community. For instance, one partner likened the KTP to a 'cricket team' where all partners had to play together as a newly established enterprise. A desire by all partners to share their expert knowledge in order to progress the project and achieve the end deliverable underpinned knowledge sharing in all three cases.

Across all KTPs an awareness of each other's knowledge and contribution to the enterprise allowed the partners to learn to work together to capitalize on strengths and overcome weaknesses. Within the KTPs, a shared repertoire was fundamental to the partners in terms of developing a common worldview to bridge the gap between university – industry communities. This is illustrated by the adoption of specific styles of language use. For instance, within one of the KTPs, the academic partner recognised the 'monosyllabic answers' that industry is looking for and therefore synthesized information given to the company partner in a language form that was useful and digestible:

> "Industry wants monosyllabic answers. Will it do? Will it work? That is it. They don't care about the background science. I understand that very well. While academics tend to write a lot and cover the subject in every minute detail which is sometimes this information is necessary but the company really wants to know if this is ok, if this works, if this is strong enough, will it break or will it not break and that is all they need to know." (DEF Academic partner)

In all three KTPs the partners learnt to adjust their language to create shared points of reference between everyone involved in the KTP. In this sense, the partners develop a shared repertoire of language and ways of working.

Moreover, through membership of the KTP project both the academic and company partner enhance their boundary spanning skills. They gain access to the collaborating partner's community as a legitimate peripheral participant. Yet, unlike the associate they remain on the margins of the community. From this position they are able to assist the associate in the introduction of new knowledge. Indeed, it is important that the company and academic partners do not become too absorbed into their collaborating organisation as a shift in their identity can lead to a failure to focus on the KTP project objectives. For instance, a member of a public sector organisation that supports KTPs highlighted this problem:

> " … sometimes the company goes native with the University so that the company guys think this has happened to me in an organisation where this is great this control is absolutely fantastic let's publish, let's do this, let's do that and I find myself the only one in the room saying when are you going to apply it to the steel rolling mill."

Consequently, within the KTP project each partner has a specific role and maintaining that role is vital to the successful achievement of the project's aims and objectives. The partners must work together, and, while the associate has a central role, the academic and company partner provide essential support that is necessary for the successful completion of the project.

8. Discussion and Implications

This article set out to examine the micro-dimensions of KTPs with the aim of developing an understanding of how knowledge is exchanged through the personal interactions that facilitate successful university-industry collaboration. The CoPs approach to situated learning is employed as a lens through which to explore knowledge transfer in KTPs. The analysis of three case studies provides evidence to support the value of conceptualising the process of knowledge transfer between universities and industry as one of learning taking place within communities. Specifically, understanding how the KTP associate is able to participate in the negotiation of meaning in the company and university communities through the adoption of a dual identity contributes to understandings of how knowledge is transferred between the collaborating organisations. Moreover, through the development of mutual engagement, joint enterprise and shared repertoires within the KTP all three partners are able to take on boundary spanning roles. Nevertheless, the KTP associate holds a pivotal place in the collaboration and is central to the knowledge transfer capacities of such projects. The evidence suggests that the associate's ability to adopt and manage two distinct identities is a key quality influencing the success of the knowledge transfer process. By focusing on the interpersonal interactions involved in the knowledge transfer process the CoPs approach provides the foundations for recommendations to improve university-industry KTPs, in particular, and, more broadly, other forms of university-industry knowledge transfer initiatives, including collaborative research and consultancy projects.

This research underlines the importance of social relationships and shared understandings to successful knowledge transfer. Moreover, it also demonstrated the value of the CoPs framework as means of unraveling the social interactions that facilitate the transfer of knowledge between diverse contexts. A number of implications for the KTP programme and for inter-personal interactions in knowledge transfer emerge from the findings.

Firstly, a shared practice and the development of mechanisms of mutual engagement were shown to be vital for lowering the barriers to exchanging knowledge. Interpersonal relationships enabled members of the community to share ideas and create clear perspectives on individual roles. Rather than managing knowledge transfer directly, the provision of the resources required to develop engagement through shared practices and joint enterprises facilitates knowledge transfer by the people who actually use the knowledge (Wenger, 2004). Therefore the promotion of knowledge exchange requires opportunities for interpersonal interaction.

Secondly, the importance of developing a shared understanding amongst the partners to facilitate knowledge transfer was highlighted in the case studies. This requires time, and it is therefore essential that sufficient time is allocated within the project to allow for meetings to discuss ideas and information. Adequate resources and spaces for social interaction need to be built into project plans (Newell et al., 2002). If knowledge is to be transferred and, indeed, created, time and space to allow for the process of negotiating the meaning of knowledge in the organisational context is required.

Thirdly, the significant role of the associate partner not only as the driver of the project but also as facilitator of knowledge transfer between university and industry was identified. The qualities of the associate are therefore central to the success of the project. An ability to adopt a dual identity and diverse perspectives appears vital. While this may be acquired during the life of the project, recruiting an associate who already possesses such skills will increase the potential for the successful completion of the KTP. Such skills often develop as

individuals mature and gain experience working and living in a variety of contexts. In addition, the need to drive the project forward suggests the need to appoint associates with leadership skills. To allow associates to work to their full potential it is essential that they receive appropriate support from the academic and company partner. As part of this support there should be a clear demarcation of responsibilities between the KTP partners.

Fourthly, the findings also have relevance for recently introduced knowledge transfer programmes including the collaborative innovation partnerships (CIPs) or mini-KTPs. These shorter 6-month programmes have the same objectives as the traditional KTP. Whether the mini-KTPs can achieve the required level of mutual engagement and shared repertoire to facilitate successful knowledge transfer in the shorter time frame is open to question. Further research is required to provide a comparison between the traditional KTP and the shorter CIP.

The KTP scheme has a long history of success, with no directly comparable schemes outside the UK. It continues to push the boundaries by offering an international dimension and has begun to work with overseas organisations such as Westlink and the Ontario Centres of Excellence in Canada (KTP 2010). There are also plans to continue to promote international links to facilitate collaboration prior to, during and after KTPs. As a result, this study may also offer insights into how the personal interactions that are so important to the success of the scheme might be replicated in other countries. Furthermore, international partnerships present additional challenges with personal interactions occurring across cultural boundaries. The findings of this research suggest that the recruitment of an appropriate associate with excellent cross-cultural and boundary spanning skills may well be crucial to the success of international KTPs.

Continued support for the traditional KTP is important to promote university-industry knowledge transfer and thereby contribute to the UK's international competitiveness in science, technology and knowledge production. However, given the current public sector funding constraints in the UK, as the government seeks to pay off the national debt incurred during the global financial crisis of 2008, there is a significant danger that the KTP scheme may be undermined by funding cuts. Already the organisation responsible for managing the scheme, the Technology Strategy Broad (TSB), has lost 50% of its government funding. In response, it has announced a narrowing of KTP activities with 75% of projects now being directed to technology-based activities (TSB, 2011).

In light of the current funding challenges, universities, companies and policy makers need to consider alternative forms of university-industry engagement. Given the findings of this research it is vital that future university-industry knowledge transfer activity includes a strong element of personal interaction. For it is this social engagement that permits knowledge, and especially tacit knowledge, to be transferred and translated from one context to another. In addition, the importance of actors who span across diverse knowledge communities, whether by adopting a dual identity or acting as a broker and boundary spanner must be recognised. Further research is required to develop a deeper appreciation of the role of boundary processes including brokers, boundary objects, joint projects and other boundary interactions in facilitating the transfer of knowledge.

A limitation of this research is its focus on the UK context. Extending the research by examining university-industry collaboration in a comparative study of US and UK would be valuable. For instance, through a comparative study of the UK KTP scheme with the Industry & University Cooperative Research Program (I/UCRC) in the US, the research could shed light on the similarities and differences between the two programmes which represent two of the oldest university-industry mechanisms still in existence today.

9. Conclusions

The central aim of this article has been to contribute to understandings of how knowledge is exchanged through the personal interactions arising from KTPs. By employing the CoPs framework as a conceptual lens it has been shown that KTPs facilitate knowledge transfer through the establishment of frequent personal interactions between the three partners and between the KTP associate and members of the two distinct communities in which the associate becomes embedded. While the associate gains dual membership of the university and industry communities, the university and industry partners act as brokers and boundary spanners between the two communities. Personal interaction coalesces around a specific project or a joint enterprise which give rise to mutual engagement and the development over time of a shared repertoire. By drawing together partners from different knowledge communities – universities and companies - the KTP offers opportunities not only to transfer knowledge but also for the creation of new knowledge as partners and their communities absorb knowledge and give it meaning and value in their own particular ways. The CoPs approach to situated learning has proved valuable in providing insights into the knowledge transfer process in KTPs. In particular, the ideas of legitimate peripheral participation, identity as competence, knowledge brokers and boundary spanners are useful in articulating the various roles of the KTP partners.

These findings suggest that for knowledge transfer to be successfully achieved through KTPs it is necessary to ensure the engagement of the partners and community members through the development of a joint enterprise. To achieve this resources are required, including the time and space to nurture relationships and identify mutual interests. In addition, the KTP associate is a key component in the knowledge transfer process and must become competent in both the university and industry community, this is achieved through the adopting of a dual identity.

The insights gained from this research can be applied more widely and they have relevance for other knowledge transfer efforts that focus on personal interaction. In university-industry collaborations this might include the commercial consulting activities of academics or research projects. In the commercial world the personal interactions involved in secondments and internships might usefully be examined for their knowledge transferring capacities.

As an exploratory study based on the analysis of three KTPs this research provides some useful insights. However, further research is required to verify the findings reported here. The knowledge transfer process is complex. It is difficult, if not impossible, to identify a definitive set of conditions required to achieve successful knowledge transfer. Dependent as it is on interactions between people the conditions vary at least as much as the people involved. Nevertheless, a number of broad knowledge transfer elements, worth further exploration, have been identified through this investigation into university-industry knowledge transfer partnerships.

Appendix 1

Categories emerging from the CoPs literature and employed in the data analysis:

- sustained mutual relationships - harmonious or conflictual;
- shared ways of engaging in doing things together;
- very quick setup of a problem to be discussed;
- the ability to assess the appropriateness of actions and products;
- mutually defining identities;
- substantial overlap in participants descriptions of who belongs;
- absence of introductory preambles, as if conversations and interactions were merely the continuation of an ongoing process;
- the rapid flow of information and propagation of innovation;
- knowing what others know, what they can do, and how they can contribute to an enterprise;
- a shared discourse reflecting a certain perspective on the world;
- certain styles recognised as displaying membership;
- local lore, shared stories, inside jokes, knowing laughter;
- specific tools, representations, and other artifacts, and jargon
- shortcuts to communication as well as the case of producing new ones.

References

Acworth, E. B., 2008. University-industry engagement: The formation of the Knowledge Integration Community (KIC) model at the Cambridge-MIT Institute, Research Policy 37, 1241-1254.

Agrawal, A., 2001. University-to-industry knowledge transfer: literature review and unanswered questions, International Journal of Management Reviews 3 (4), 285-302.

Amin, A. and Cohendet, P., 2004. Architectures of Knowledge: firms, capabilities, and communities, Oxford University Press, Oxford.

Amin, A. and Roberts J., 2008. Knowing in action: Beyond communities of practice, Research Policy 37(2), 353-369.

Arrow, K. J., 1974. The Limits of Organization, W. W. Norton & Company, New York and London.

Ardichvili, A., Page, V. and Wentling, T., 2003. Motivation and barriers to participation in virtual knowledge-sharing communities of practice, *Journal of Knowledge Management* 7(1) 64–77.

Arvanitis, S., Kubli, U. and Woerter, M., 2008. University-industry knowledge and technology transfer in Switzerland: What university scientists think about co-operation with private enterprises, Research Policy 37 (10), 1865-1883.

Bjerregaard, T., 2010. Industry and academia in convergence: Micro-institutional dimensions of R&D collaboration, Technovation 30(2), 100-108.

Blumenthal, D., Gluck, M., Louis, K.S., Stoto, M.A., and Wise, D., 1986. University-

industry research relationships in biotechnology: implications for the university, Science 232(4756), 1361-1366.

Boardman, C.P. and Ponomariov B.L., 2009. University researchers working with private companies, Technovation 29(2), 142-153.

Brown, J. S. and Duguid P., 2001. Knowledge and organization: a social-practice perspective, Organization Science, 12 (2), 198–213.

Brown, J. S. and Duguid P., 1991. Organizational learning and communities of practice: toward a unified view of working, learning and innovation, Organization Science 2(1), 40-57.

Brown, J. S. and Duguid P., 1998. Organizing knowledge, California Management Review 40(3), 90-111.

Brown, J. S. and Duguid, P., 2000. Balancing act: How to capture knowledge without killing it. Harvard Business Review, May-Jun; 78(3), 73-80.

Bruneel, J., D'Este, P. and Salter A., 2010. Investigating the factors that diminish the barriers to university-industry collaboration, Research Policy 39, 858-868.

Bryman, A. and Bell E., 2007. Business Research Methods. Oxford, Oxford University Press.

Bureau of Industry Economics, 1991. The National Teaching Company Scheme: Program Evaluation Report 10, Canberra, Australian Government Publishing Services.

Burvill, C. R. and Leary M. J., 2001. An Australian technology transfer scheme, Industry and Higher Education 15, 48-54.

Carlile, P. R., 2002. A pragmatic view of knowledge and boundaries: boundary objects in new product development, Organization Science, 3(4), 442-455.

Charles, D. and Howells J., 1992. Technology transfer in Europe: public and private networks. London ; New York, Belhaven Press.

Cohen, W. M., Nelson, R. R, and Walsh, J.P.,, 2002. Links and impacts: the influence of public research on industrial R&D, Management Science 48(1), 1-23.

Contu, A. and Willmott H., 2003. Re-embedding situatedness: the importance of power relations in learning theory, Organization Science, 14(3), 283-296.

Day, D. I., 1994. Raising radicals: different processes for championing innovative corporate ventures, Organization Science 5(2), 148-172.

Eisenhardt, K. M., 1989. Building theories from case study research. Academy of Management Review 14(4): 532-550.

Eisenhardt, K. M. and Graebner, M. E. (2007). Theory building from cases: Opportunities and challenges. Academy of Management Journal 50(1): 25-32.

Este, P. D. and Patel P., 2007. University-industry linkages in the UK: What are the factors underlying the variety of interactions with industry? Research Policy 36, 1295-1313.

Faulconbridge, J.R., 2007. Exploring the role of professional associations in collective learning in London and New York's advertising and law professional service firm clusters. Environment and Planning A 39, 965–984.

Fini, R., Lacetera N. and Shane S., 2010. Inside or outside the IP system? Business creation in academia, Research Policy 39, 1060-1069.

Fox, S., 2000. Communities of practice, Foucault and actor-network theory, Journal of Management Studies 37(6), 853-67.

Gaskell, G., 2000. Individual and Group Interviewing, in M. W. Bauer and G. Gaskell, (eds), Qualitative Researching with text, image and sound,.. London, Sage, pp. 38-56

Gherardi, S., 2006. Organizational Knowledge: The Texture of Workplace Learning, Oxford, Blackwell Publishing.

Giudice, D. M., Formica, P., and Carayannis, E., 2008. Special Issue Industry and research: cross-cultural perspectives on knowledge transfer and entrepreneurial interaction. Industry and Higher Education 22(6), 337-342.

Grant, R. M., 1996. Toward a knowledge-based theory of the firm. Strategic Management Journal, 17, 109-122.

Gray, D. O. and Walters, S. G., 1998. Managing the industry university cooperative research center: A guide for directors and other stakeholders. Columbus, Battelle Press.

Gubrium, J. F. and Sankar A., 1994. Qualitative Methods in Aging Research. Thousand Oaks, Sage Publications, Inc.

Handley, K., Sturdy, A. Fincham, R., Clark, T., 2006. Within and beyond communities of practice: making sense of learning through participation, identity and practice, Journal of Management Studies 43(3), 641-653.

Howells, J., 2000. Industry-Academic Job Links in the UK: Crossing Boundaries. CRIC Briefing Paper Series, No. 4, Manchester, The University of Manchester & UMIST.

Howells, J., 2006. Intermediation and the role of intermediaries in innovation, Research Policy 35, 715–728.

Hughes, A., 2008. University-industry links and UK science and innovation policy, in S. Yusuf and K. Nabeshima (eds) How Universities Promote Economic Growth, The World Bank, Washington DC.Kitson, M., Howells, J., Braham, R. and Westlake, S., 2009. The Connected University: Driving Recovery and Growth in the UK Economy, London, NESTA.

KTP, 2009. Knowledge Transfer Partnerships: Annual Report 2008/09, London, Technology Strategy Board.

KTP, 2010. What are the aims of Knowledge Transfer Partnerships? Available at: http://www.ktponline.org.uk/faqs/faqs.aspx. (Accessed 13/02/10)

Lambert, R., 2003. Lambert Review of Business-University Collaboration. London, Her Majesty's Stationery Office. Available at: www.lambertreview.org.uk (Accessed 22/02/10).

Lave, J. and Wenger E., 1991. Situated Learning: Legitimate Peripheral Participation, Cambridge, Cambridge University Press.

Lindkvist, L., 2005. Knowledge Communities and Knowledge Collectivities: A Typology of Knowledge Work in Groups, Journal of Management Studies 42 (6), 1189-1210.

Mansfield, E., 1991. Academic research and industrial innovation, Research Policy, 20, 1-12.

McGovern, T. and Hicks C., 2004. How political processes shaped the IT adopted by a small make-to-order company: a case study in the insulated wire and cable industry, Information & Management 42, 243-257.

Mueller, P., 2006. Exploring the knowledge filter: How entrepreneurship and university-industry relationships drive economic growth, Research Policy 35, 1499-1508.

Mutch, A., 2003. Communities of practice and habitus: a critique, Organization Studies, 24(3), 383-401.

Newell, S., Robertson, M. and Scarbrough, H., 2002. Managing knowledge work, New York, Palgrave Macmillan.

Neuendorf, K. A., 2002. The content analysis guidebook. Thousand Oaks, Sage Publications, Inc.

Nooteboom, B., 2008 Cognitive distance in and between communities of practice and firms: where do exploitation and exploration take place, and how are they connected? in Amin, A. and Roberts, J. (eds) Community, Economic Creativity and Organization, Oxford University Press, Oxford, pp. 123-147.

NSF, 2010. Industry and university cooperative research program (I/UCRC). Available at http://www.nsf.gov/eng/iip/iucrc/ (Accessed18/03/2011) .

Peattie, K., 1993. The Teaching Company Scheme: effecting organizational change through academic/practitioner collaboration, Journal of Management Development 12(4), 59-72.

Perkmann, M. and Walsh K., 2007. University-industry relationships and open

innovation: Towards a research agenda, International Journal of Management Reviews 9, 259-280.

Ritchie, J. and Spencer L., 1994. Qualitative data analysis for applied policy research in A. Bryman and R. G. Burgess, (eds), Analyzing Qualitative Data. London, Routledge, pp. 208-238.

Roberts, J., 2010. Communities of Management Knowledge Diffusion. Prometheus: Critical Studies in Innovation, 28(2), 111-132.

Roberts, J., 2006. Limits to communities of practice, Journal of Management Studies 43(3), 623-639.Roberts, J., 2000. From know-how to show-how? Questioning the role of information and communication technologies in knowledge transfer. Technology Analysis & Strategic Management 12(4), 429 – 443.

Robson, E. H., 1996. Linking small firms with higher education, Industry and Higher Education 10(2), 103-108.

Schartinger, D., Rammer, C., Fischer M.M. and Frölich J., 2002 Knowledge interactions between universities and industry in Austria: sectoral patterns and determinants, Research Policy 31, 303-328.

Senker, J., Senker, P. and Hall, A., 1993. Teaching Company Performance and Features of Successful Programmes. Falmer, University of Sussex.

Senker, P. and Senker J., 1994. Transferring technology and expertise from universities to industry: Britain's Teaching Company Scheme, New Technology, Work and Employment 9(2), 81-92.

Siggelkow, N. (2007). Persuasion with case studies, Academy of Management Journal 50(1): 20-24.

Star, S. L. and Griesemer J. R., 1989. Institutional ecology, 'translations' and boundary objects: amateurs and professionals in Berkeley's Museum of Vertebrate Zoology, 1907-39, Social Studies of Science 19(3), 387-420.Szulanski, G., 2003. Sticky knowledge: barriers to knowing in the firm, London, Sage Publications.

Technology Strategy Board, 2010. Criteria for support of knowledge transfer partnerships, Press Release, Technology Strategy Board Available at: www.inovateuk.org. (Accessed 10/01/11).

Tiler, C. and Gibbons M., 1991. A case study of organizational learning: the UK Teaching Company Scheme, Industry and Higher Education 5, 47-55.

Trompenaars, F., 1996. Resolving international conflict: culture and business strategy, Business Strategy Review 7(3), 51-68.

Tushman, M. and Scandal T., 1981. Boundary spanning individuals: their role in information transfer and their antecedents, Academy of Management Journal 24(2), 289 - 305.

Wenger, E., 1998. Communities of Practice: Learning, Meaning, and Identity, Cambridge, Cambridge University Press.

Wenger, E., 2000. Communities of practice and social learning systems, Organization, 7(2), pp. 225-246.

Wenger, E. 2004. Knowledge management as a doughnut: Shaping your knowledge strategy through communities of practice, Ivey Business Journal 68(3), 1-8.

Wenger, E. C. and Snyder W. M., 2000. Communities of practice: The organizational frontier, Harvard Business Review January – February, 139-145.

Wenger, E., McDermott, R. and Snyder, W.M., 2002. Cultivating Communities of Practice: A Guide to Managing Knowledge, Boston, Massachusetts: Harvard Business School Press.

Yin, R. K., 1994. Case study research: Design and Methods. Newbury Park, Sage Publications, Inc.

Table 1. KTP case studies: key features, partnership objectives, partner inputs and outputs

KTP: Key Features	Partnership Objectives	Partner Inputs	Partner Outputs
Community High School (CHS) 2 ½ year duration in a public sector organisation with over 250 employees. At the outset the school's transmission model of teaching was quite poor with students being merely passive recipients of information. Focusing on 7, 8 and 9 key stage 3[1], a new teaching model facilitated by the KTP would empower students to take responsibility for their learning to improve staying on rates, grades and general attitudes.	• Design a model for teaching of enquiry skills moving quality of teaching from satisfactory to outstanding • Develop an assessment framework and recording of learning outcomes in digital portfolios • Test out academic theories to support schools in enacting change	**Academic Partner** • A broad range of knowledge and experience in teaching thinking strategies • Support for associate with meetings and research material **Associate Partner** • Contribution of teaching background • Outgoing personality • Strong communication skills **Company Partner** • Context expertise as a teacher who was often observed by other classroom practitioners • Strong commitment to KTP	**Academic Partner** • Tested theories and ideas • Data collection and potential publication **Associate Partner** • Professional development and training • CIM[2] degree and doctorate in Education **Company Partner** • International exposure from overseas visitors Exposure to local authorities though the co-development of new projects • New insights in theories on teaching
Window and Cladding System Firm (WCSF) 2 ½ year duration in a private sector organisation with less than 250 employees. At the beginning of this KTP programme, the company found itself in an expanding market but lacking knowledge of how to grow their production facilities whilst balancing investment capacity and efficiency.	• Establish a modernised production line to allow for larger jobs • Acquire new knowledge to enable the company to grow and expand financially • Develop a highly skilled associate as a possible future employee post KTP	**Academic Partner** • KTP history and understanding of how to steer project • Industrial awareness • High involvement and support for associate partner **Associate Partner** • Enthusiasm and hard work • Outgoing personality • Strong communication skills • Masters in Engineering **Company Partner** • Industrial experience • Strong Commitment to KTP	**Academic Partner** • New insights from industry • Understanding of how to deliver change within an organisation **Associate Partner** • Key player in the organisation on specific project • Job opportunity **Company Partner** • Insights from academic theory • Development of new production line

Table 1. KTP case studies: partnership objectives, partner inputs and outputs continued

KTP: Key Features	Partnership Objectives	Partner Inputs	Partner Outputs
Design and Engineer Firm (DEF) 2 year and 7 month duration in a private sector organisation with over 250 employees. At the beginning of the KTP the firm, although at the limits of its structural capacity, wished to exploit new market opportunities across the world in deep offshore water. The KTP provided a dedicated resource and a knowledge base with the required expertise to access information regarding the broad range of alloys necessary to develop deep-water capabilities.	• Identify materials for use on flexible pipes • Initial testing of materials for service conditions • Set up a manufacturing route for pipes	**Academic Partner** • Broad range of industrial knowledge and experience • Commitment to associate partner **Associate Partner** • PhD in engineering • Dedicated resource for organisation • Reserved personality **Company Partner** • Day-to-day contact with the associate • Constructive suggestions towards the project • Strong commitment to KTP	**Academic Partner** • Data collection and possible publications **Associate Partner** • Increased knowledge in niche engineering area • Industrial contacts of key vendors and material manufacturers **Company Partner** • R&D for pipe development

Notes

1. Key stage 3 is the three years of schooling in maintained schools in England and Wales normally known as Year 7, Year 8 and Year 9 when students are aged between 11 and 14:
2. The Chartered Institute of Marketing is an organisation for professional marketers which deliver internationally recognized accredited practice-based qualifications and training.

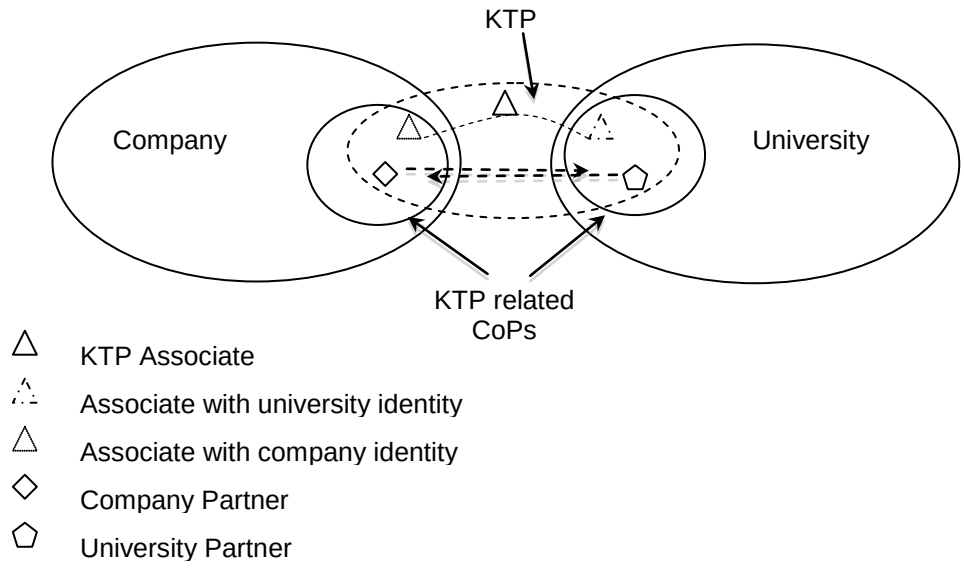

Figure 1. Communties of Practice in KTPs